01-14-00

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Practitioner's Docket No. ___460-009132-US(PAR)___   *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s):   Kari LAURILA,   Juha HAKKINEN,   Ramalingam HARIHARAN

> *WARNING:* *37 C.F.R. § 1.41(a)(1) points out:*
>
> *"(a) A patent is applied for in the name or names of the actual inventor or inventors.*
>
> *"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors."*

For (title):

METHOD IN SPEECH RECOGNITION AND A SPEECH RECOGNITION DEVICE

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date ___January 13, 2000___, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number ___EL067144491US___, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Shauna Murphy
_____
(type or print name of person mailing paper)

[signature]
_____
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

*WARNING: *Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

1. Type of Application

This new application is for a(n)

(check one applicable item below)

☒ Original (nonprovisional)

☐ Design

    ☐ Plant

WARNING: *Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. § 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: *Do not use this transmittal for the filing of a provisional application.*

NOTE: *If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.*

☐ Divisional.

☐ Continuation.

☐ Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. §§ 119(e), 120, or 121)

NOTE: *A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. § 112. Each prior application must also be:*

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

NOTE: *If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICA-TION(S) CLAIMED.*

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§ 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. § 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: *When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).*

☐ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

_14_ Pages of specification

_4_ Pages of claims

_4_ Sheets of drawing

WARNING: *DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. § 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).*

NOTE: *"Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. § 1.84(c)).*

(complete the following, if applicable)

☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. § 1.84(b).

☐ formal

☐ informal

B. Other Papers Enclosed

_6_ Pages of declaration and power of attorney

_1_ Pages of abstract

____ Other

4. Additional papers enclosed

☐ Amendment to claims

    ☐ Cancel in this applications claims _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

    ☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)

☒ Preliminary Amendment

☒ Information Disclosure Statement (37 C.F.R. § 1.98)

☒ Form PTO–1449 (PTO/SB/08A and 08B)

☒ Citations

☐ Declaration of Biological Deposit

☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative

☐ Special Comments

☐ Other

5. Declaration or oath (including power of attorney)

NOTE: A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)–(3).

NOTE: A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)–(4).

☒ Enclosed

Executed by

(check all applicable boxes)

☒ inventor(s).

☐ legal representative of inventor(s).
37 C.F.R. §§ 1.42 or 1.43.

☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ This is the petition required by 37 C.F.R. § 1.47 and the statement required by 37 C.F.R. § 1.47 is also attached. *See* item 13 below for fee.

☐ Not Enclosed.

NOTE: Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

☐ Application is made by a person authorized under 37 C.F.R. § 1.41(c) on behalf of *all* the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 C.F.R. § 1.16(e) can be filed subsequently).

☐ Showing that the filing is authorized.
(not required unless called into question. 37 C.F.R. § 1.41(d))

6. Inventorship Statement

WARNING: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of $130.00 required by 37 C.F.R. § 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 C.F.R. § 1.52(d).

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. § 1.52(d).

8. Assignment

☒ An assignment of the invention to ___Nokia Mobile Phones Ltd.___

___

☒ is attached. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: A newly executed "CERTIFICATE UNDER 37 C.F.R. § 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

(New Application Transmittal [4-1]—page 5 of 11)

9. Certified Copy

Certified copy(ies) of application(s)

Country	Appln. No.	Filed
Finland	990078	18 January 1999

Country	Appln. No.	Filed

Country	Appln. No.	Filed

from which priority is claimed

   ☒ is (are) attached.

   ☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 C.F.R. § 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. § 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. § 1.16)

A. x☒ Regular application

CLAIMS AS FILED			
Number filed	Number Extra	Rate	Basic Fee 37 C.F.R. § 1.16(a) $ 690.00
Total Claims (37 C.F.R. § 1.16(c)) 11 − 20 =	0 ×	$ 18.00	0
Independent Claims (37 C.F.R. § 1.16(b)) 3 − 3 =	0 ×	$ 78.00	0
Multiple dependent claim(s), if any (37 C.F.R. § 1.16(d))	+	$260.00	

   ☐ Amendment cancelling extra claims is enclosed.

   ☒ Amendment deleting multiple-dependencies is enclosed.

   ☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 C.F.R. § 1.16(d).

                           Filing Fee Calculation $ 690.00

B. ☐ Design application
     ($310.00—37 C.F.R. § 1.16(f))

                           Filing Fee Calculation $_____

C. ☐ Plant application
     ($480.00—37 C.F.R. § 1.16(g))

                           Filing fee calculation $_____

11. Small Entity Statement(s)

☐ Statement(s) that this is a filing by a small entity under 37 C.F.R. § 1.9 and 1.27 is (are) attached.

WARNING: *"Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. § 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).*

WARNING: *"Small entity status must not be established when the person or persons signing the . . . statement can unequivocally make the required self-certification." M.P.E.P., § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).*

(complete the following, if applicable)

☐ Status as a small entity was claimed in prior application

_____ / _____, filed on _____, from which benefit is being claimed for this application under:

35 U.S.C. § ☐ 119(e),
         ☐ 120,
         ☐ 121,
         ☐ 365(c),

and which status as a small entity is still proper and desired.

☐ A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of **A, B** or **C** above)

$_____

NOTE: *Any excess of the full fee paid will be refunded if small entitiy status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 C.F.R. § 1.28(a).*

12. Request for International-Type Search (37 C.F.R. § 1.104(d))

(complete, if applicable)

☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

☐ Not Enclosed

    ☐ No filing fee is to be paid at this time.
    (This and the surcharge required by 37 C.F.R. § 1.16(e) can be paid subsequently.)

☒ Enclosed

    ☒ Filing fee $ 690.00

    ☒ Recording assignment
       ($40.00; 37 C.F.R. § 1.21(h))
       (See attached "COVER SHEET FOR
       ASSIGNMENT ACCOMPANYING NEW
       APPLICATION".) $ 40.00

    ☐ Petition fee for filing by other than all the
       inventors or person on behalf of the inventor
       where inventor refused to sign or cannot be
       reached
       ($130.00; 37 C.F.R. §§ 1.47 and 1.17(i)) $ _____

    ☐ For processing an application with a
       specification in
       a non-English language
       ($130.00; 37 C.F.R. §§ 1.52(d) and 1.17(k)) $ _____

    ☐ Processing and retention fee
       ($130.00; 37 C.F.R. §§ 1.53(d) and 1.21(l)) $ _____

    ☐ Fee for international-type search report
       ($40.00; 37 C.F.R. § 1.21(e)) $ _____

NOTE: 37 C.F.R. § 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 C.F.R. § 1.53(f) and this, as well as the changes to 37 C.F.R. §§ 1.53 and 1.78(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(f).

                     Total fees enclosed $ 730.00

14. Method of Payment of Fees

☒ Check in the amount of $ 730.00

☐ Charge Account No. _____ in the amount of
    $_____.
    A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing, the following items should <u>not</u> be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

[X] The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. <u>16-1350</u> :

    [X] 37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

    [X] 37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

    [X] 37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

    [X] 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a)).

    [ ] 37 C.F.R. § 1.17 (application processing fees)

NOTE: ". . .A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

    [ ] 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . " From the wording of 37 C.F.R. § 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

(New Application Transmittal [4-1]—page 9 of 11)

16. Instructions as to Overpayment

NOTE: ". . . Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).
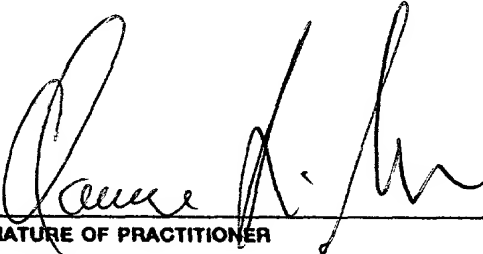
☒ Credit Account No. ___16-1350___

☐ Refund

SEND ALL CORRESPONDENCE TO:

Reg. No. 24,622

Tel. No. (203)   259-1800

Customer No.

_____

SIGNATURE OF PRACTITIONER

Clarence A. Green

(type or print name of attorney)

PERMAN & GREEN, LLP

P.O. Address

425 Post Road, Fairfield, Connecticut 06430

_____

(New Application Transmittal [4-1]—page 10 of 11)

☐ **Incorporation by reference of added pages**

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

☐ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

☒ **Statement Where No Further Pages Added**

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

☒ This transmittal ends with this page.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail No.: EL067144491US

In re Application of: LAURILA et al.

SERIAL NUMBER: EXAMINER:

FILING DATE: Herewith   ART UNIT:

TITLE: METHOD IN SPEECH RECOGNITION AND A SPEECH RECOGNITION DEVICE

ATTORNEY DOCKET NO.: 460-009132-US(PAR)

The Commissioner of Patents and Trademarks

Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the above-identified, enclosed patent application as follows:

IN THE CLAIMS:

Please amend Claims 4, 5 and 10 as shown below.

Claim 4, line 1, delete "2 or 3,".

Claim 5, line 1, delete "any of the claims 1 to 4" and insert --claim 1--.

Claim 10, line 1, delete "or 9".

Remarks

Please enter this preliminary prior to calculation of the fees.

Respectfully submitted,

Clarence A. Green, Reg. No. 24,622
Perman & Green, LLP
425 Post Road
Fairfield, CT 06430
(203) 259-1800

15 Jan 00
Date

Method in speech recognition and a speech recognition device

The present method relates to a method in speech recognition as set
forth in the preamble of the appended claim 1, a speech recognition
device as set forth in the preamble of the appended claim 8, and a
speech-controlled wireless communication device as set forth in the
preamble of the appended claim 11.

For facilitating the use of wireless communication devices, speech
recognition devices have been developed, whereby a user can utter
speech commands which the speech recognition device attempts to
recognize and convert to a function corresponding to the speech com-
mand, *e.g.* a command to select a telephone number. A problem in the
implementation of speech control has been for example the fact that
different users say the speech commands in different ways: the speech
rate can be different between different users, so does the speech
volume, voice tone, *etc.* Furthermore, speech recognition is disturbed
by a possible background noise, whose interference outdoors and in a
car can be significant. Background noise makes it difficult to recognize
words and to distinguish between different words *e.g.* upon uttering a
telephone number.

Some speech recognition devices apply a recognition method based on
a fixed time window. Thus, the user has a predetermined time within
which s/he must utter the desired command word. After the expiry of
the time window, the speech recognition device attempts to find out
which word/command was uttered by the user. However, such a
method based on a fixed time window has *e.g.* the disadvantage that all
the words to be uttered are not equally long; for example, in names, the
given name is often clearly shorter than the family name. Thus, after a
shorter word, more time will be consumed for the recognition than in the
recognition of a longer word. This is inconvenient for the user. Further-
more, the time window must be set according to slower speakers so
that recognition will not be started until the whole word is uttered. When
words are uttered faster, a delay between the uttering and the recogni-
tion increases the inconvenient feeling.

Another known speech recognition method is based on patterns formed of speech signals and their comparison. Patterns formed of command words are stored beforehand, or the user may have taught desired words which have been formed into patterns and stored. The speech

5 recognition device compares the stored patterns with feature vectors formed of sounds uttered by the user during the utterance and calculates the probability for the different words (command words) in the vocabulary of the speech recognition device. When the probability for a command word exceeds a predetermined value, the speech recognition

10 device selects this command word as the recognition result. Thus, incorrect recognition results may occur particularly in the case of words in which the beginning resembles phonetically another word in the vocabulary. For example, the user has taught the speech recognition device the words "Mari" and "Marika". When the user is saying the word

15 "Marika", the speech recognition device may make "Mari" as the recognition decision, even though the user may not yet have had time to articulate the end of the word. Such speech recognition devices typically use the so-called Hidden Markov Model (HMM) speech recognition method.

20

U.S. patent 4,870,686 presents a speech recognition method and a speech recognition device, in which the determination of the end of words by the user is based on silence; in other words, the speech recognition device examines if there is a perceivable audio signal or not.

25 A problem in this solution is the fact that a too loud background noise may prevent the detection of pauses, wherein the speech recognition is not successful.

It is an aim of the present invention to provide an improved method for

30 detecting pauses in speech and a speech recognition device. The invention is based on the idea that a tone band to be examined is divided into sub-bands, and the power of the signal is examined in each sub-band. If the power of the signal is below a certain limit in a sufficient number of sub-bands for a sufficiently long time, it is deduced that there

35 is a pause in the speech. The method of the present invention is characterized in what will be presented in the characterizing part of the appended claim 1. The speech recognition device according to the present invention is characterized in what will be presented in the char-

acterizing part of the appended claim 8. The wireless communication device of the present invention is characterized in what will be presented in the characterizing part of the appended claim 11.

5   The present invention gives significant advantages to the solutions of prior art. By the method of the invention, a more reliable detection of a gap between words can be obtained than by methods of prior art. Thus, the reliability of the speech recognition is improved and the number of incorrect and failed recognitions is reduced. Furthermore, the speech

10   recognition device is more flexible with respect to manners of speaking by different users, because the speech commands can be uttered more slowly or faster without an inconvenient delay in the recognition or recognition taking place before an utterance has been completed.

15   By the division into sub-bands according to the invention, it is possible to reduce the effect of external interference. Spurious signals *e.g.* in a car have typically a relatively low frequency. In solutions of prior art, the energy contained in the whole frequency range of the signal is utilized in the recognition, wherein signals which are strong but have a narrow

20   band width reduce the signal-to-noise ratio to a significant degree. Instead, if the frequency range to be examined is divided into sub-bands according to the invention, the signal-to-noise ratio can be improved significantly in such sub-bands in which the proportion of spurious signals is relatively small, which improves the reliability of the rec-

25   ognition.

In the following, the present invention will be described in more detail with reference to the appended drawings, in which

30   Fig. 1   is a flow chart illustrating the method according to an advantageous embodiment of the invention,

Fig. 2   is a reduced flow chart showing the speech recognition device according to an advantageous embodiment of the

35   invention,

Fig. 3   is a state machine chart illustrating rank-order filtering to be applied in the method according to an advantageous embodiment of the invention, and

5   Fig. 4   is a flow chart illustrating the logic for deducing a pause to be applied in the method according to an advantageous embodiment of the invention.

The following is a description on the function of the method according
10   to an advantageous embodiment of the invention, with reference to the flow chart of Fig. 1 and using as an example a speech-controlled wireless communication device MS according to the flow chart of Fig. 2. In the speech recognition, an acoustic signal (speech) is converted, in a way known as such, into an electrical signal by a microphone, such as
15   a microphone 1a in the wireless communication device MS or a microphone 1b in a hands-free facility 2. The frequency response of the speech signal is typically limited to the frequency range below 10 kHz, e.g. in the frequency range from 100 Hz to 10 kHz. However, the frequency response of speech is not constant in the whole frequency
20   range, but there are more lower frequencies than higher frequencies. Furthermore, the frequency response of speech is different for different persons. In the method of the invention, the frequency range to be examined is divided into narrower sub-frequency ranges (M number of sub-bands). This is represented by block 101 in the appended Fig. 1.
25   These sub-frequency ranges are not made equal in width but taking into account the characteristic features of the speech, wherein some of the sub-frequency ranges are narrower and some are wider. At the low frequencies characteristic of speech, the division is denser, i.e. the sub-frequency ranges are narrower than for the higher frequencies, which
30   frequencies are more rare in speech. This idea is also applied in the Mel frequency scale, known as such, in which the width of frequency bands is based on the logarithmic function of frequency.

In connection with the division into sub-bands, the signals of the sub-
35   bands are converted to a smaller sample frequency, e.g. by under-sampling or by low-pass filtering. Thus, samples are transferred from the block 101 to further processing at this lower sampling frequency. This sampling frequency is advantageously ca. 100 Hz, but it is obvious

that also other sampling frequencies can be applied within the scope of the present invention. These samples are converted into said feature vectors.

5 A signal formed in the microphone 1a, 1b is amplified in an amplifier 3a, 3b and converted into digital form in an analog-to-digital converter 4. The precision of the analog-to-digital conversion is typically in the range from 12 to 32 bits, and in the conversion of a speech signal, samples are taken advantageously 8'000 to 14'000 times a second, but the
10 invention can also be applied at other sampling rates. In the wireless communication device MS of Fig. 2, the sampling is arranged to be controlled by a controller 5. The audio signal in digital form is transferred to a speech recognition device 16 which is in a functional connection with the wireless communication device 16 and in which differ-
15 ent stages of the method according to the invention are processed. The transfer takes place *e.g.* via interface blocks 6a, 6b and an interface bus 7. In practical solutions the speech recognition device 16 can as well be arranged in the wireless communication device 16 itself or in another speech-controlled device, or as a separate auxiliary device or
20 the like.

The division into sub-bands is made preferably in a first filter block 8, to which the signal converted into digital form is conveyed. This first filter block 8 consists of several band-pass filters which are in this advanta-
25 geous embodiment implemented with digital technique and whose frequency ranges and band widths of the pass band differ from each other. Thus each band filtered part of the original signal passes the respective band-pass filter. For clarity, these band-pass filters are not shown separately in Fig. 2. These band-pass filters are implemented
30 advantageously in the application software of a digital signal processor (DSP) 13, which is known as such.

At the next stage 102, the number of sub-bands is reduced preferably by decimating in a decimating block 9, wherein L number of sub-bands
35 are formed (L < M), their energy levels being measurable. On the basis of the signal power levels of these sub-frequency ranges, it is possible to determine the signal energy in each sub-band. Also, the decimating

block 9 can be implemented in the application software of the digital signal processor 13.

An advantage obtained by the division into M sub-bands according to the block 1 is that the values of these M different sub-bands can be utilized in the recognition to verify the recognition result particularly in an application using coefficients according to the Mel frequency scale. However, the block 101 can also be implemented by forming directly L sub-bands, wherein the block 102 will not be necessary.

A second filter block 10 is provided for low pass filtering of signals of the sub-bands formed at the decimating stage (stage 103 in Fig. 1), wherein short changes in the signal strength are filtered off and they cannot have a significant effect in the determination of the energy level of the signal in further processing. After the filtration, a logarithmic function of the energy level of each sub-band is calculated in block 11 (stage 104) and the calculation results are stored for further processing in sub-band specific buffers formed in memory means 14 (not shown). These buffers are advantageously of the so-called FIFO type (First In - First Out), in which the calculation results are stored as figures of *e.g.* 8 or 16 bits. Each buffer accommodates N calculation results. The value N depends on the application in question. Thus, the calculation results p(t) stored in the buffer represent the filtered, logarithmic energy level of the sub-band at different measuring instants.

An arrangement block 12 performs so-called rank order filtering for the calculation results (stage 105), in which the mutual rank of the different calculation results are compared. At this stage 105, it is examined in the sub-bands whether there is possibly a pause in the speech. This examination is shown in a state machine chart in Fig. 3. The operations of this state machine are implemented substantially in the same way for each sub-band. The different functional states S0, S1, S2, S3 and S4 of the state machine are illustrated with circles. Inside these state circles are marked the operations to be performed in each functional state. The arrows 301, 302, 303, 304 and 305 illustrate the transitions from one functional state to another. In connection with these arrows are marked the criteria, whose realization will set off this transition. The curves 306, 307 and 308 illustrate the situation in which the functional

state is not changed. Also these curves are provided with the criteria for maintaining the functional state.

In the functional states S1, S2 and S3, a function f() is shown, which
5 represents the performing of the following operations in said functional states: preferably N calculation results p(t) are stored in the buffer, and the lowest maximum value p_min(t) and the highest minimum value p_min(t) are determined advantageously by the following formulae:

10
$$p\_min(t) = min\big[max\langle p(i-N+1), p(i-N+2),...,p(i)\rangle\big], \quad i = N, N+1,...,t$$
$$p\_max(t) = max\big[min\langle p(i-N+1), p(i-N+2),...,p(i)\rangle\big], \quad i = N, N+1,...,t$$

Consequently, in the function f(t), the maximum value p_max(t)
searched is the highest minimum value and the minimum value
15 p_min(t) is the lowest maximum value of the calculation results p(i)
stored in the different sub-band buffers. After this, the median power
$p(t)_m$ is calculated, which is the median value of the calculation results
p(t) stored in the buffer, and a threshold value thr by the formula
$thr = p\_min + k \cdot (p\_max - p\_min)$, in which 0 < k < 1. Next, in the func-
20 tion f(), a comparison is made between the median power $p(t)_m$ and the
threshold value calculated above. The result of the calculation will set
off different operations depending on the functional state in which the
state machine is at a given time. This will be described in more detail
hereinbelow in connection with the description of the different functional
25 states.

After storing a group of sub-band specific calculation results p(t) of the
speech (N results per sub-band), the speech recognition device will
move on to execute said state machine, which is implemented in the
30 application software of either the digital signal processor 13 or the con-
troller 5. The timing can be made in a way known as such, preferably
with an oscillator, such as a crystal oscillator (not shown). The execut-
ing is started from the state S0, in which the variables to be used in the
state machine are set in their initial values (init()): a pause counter C is
35 set to zero, the power minimum p_min at the starting moment t = 1
(p_min(t = 1)) is set to the theoretical value of ∞, in practice to the high-
est possible numerical value available in the speech recognition device.

This maximum value is influenced by the number of bits these power values are calculated with. Correspondingly, the power maximum p_max at the starting moment $t = 1$ (p_max ($t = 1$)) is set to the theoretical value of $-\infty$, in practice to the lowest possible numerical value available in the speech recognition device.

After setting of the initial values, the function moves on to the state S1, in which the operations of said function f() are performed, wherein *e.g.* the power minimum p_min and the power maximum p_max as well as the median power $p(t)_m$ are calculated. In the functional state S1, also the pause counter C is increased by one. This functional state prevails until the expiry of a predetermined initial delay. This is determined by comparing the pause counter C with a predetermined beginning value BEG. At the stage when the pause counter C has reached the beginning value BEG, the operation moves on to state S2.

In the functional state S2, the pause counter C is set to zero and the operations of the function f() are performed, such as storing of the new calculation result p(t), and calculation of the power minimum p_min, the power maximum p_max as well as the median power $p(t)_m$ and the threshold value thr. The calculated threshold value and the median power are compared with each other, and if the median power is smaller than the threshold value, the operation moves on to state S3; in other cases, the functional state is not changed but the above-presented operations of this functional state S2 are performed again.

In the functional state S3, the pause counter C is increased by one and the function f() is performed. If the calculation indicates that the median power is still smaller than the threshold value, the value of the pause counter C is examined to find out if the median power has been below the power threshold value for a certain time. Expiry of this time limit can be found out by comparing the value of the pause counter C with an utterance time limit END. If the value of the counter is greater than or equal to said expiry time limit END, this means that no speech can be detected on said sub-band, wherein the state machine is exited.

However, if the comparison of the threshold value and the median power in the functional state S3 showed that the median power ex-

ceeded the power threshold value, it can be deduced that speech is detected on this sub-band, and the state machine returns to the functional state S2, in which *e.g.* the pause counter C is reset and the calculation is started from the beginning.

Consequently, the operation of a state machine to be used in the method according to an advantageous embodiment of the invention was described above in a general manner. In a speech recognition device according to the invention, the above-presented functional stages are performed separately for each sub-band.

Sampling a speech signal is performed advantageously at intervals, wherein the stages 101—104 are performed after the calculation of each feature vector, preferably at intervals of *ca.* 10 ms. Correspondingly, in the state machine of each sub-band, the operations according to the each active functional state are performed once (one calculation time), *e.g.* in state S3 the pause counter C(s) of the sub-band in question is increased, the function f(s) is performed, wherein *e.g.* a comparison is made between the median power and the threshold value, and on the basis of the same, the functional state is either retained or changed.

After one calculating round has been performed for the state machines of all the sub-bands, the operation moves on to stage 106 in the speech recognition, wherein it is examined on the basis of the information received from the different sub-bands whether a sufficiently long pause has been detected in the speech. This stage 106 is illustrated as a flow chart in the appended Fig. 4. For clarifying the examination, some comparison values are determined, which are given initial values preferably in connection with the manufacture of the speech recognition device, but if necessary, these initial values can be changed according to the application in question and the usage conditions. The setting of these initial values is illustrated with block 401 in the flow chart of Fig. 4:

— activity threshold SB_ACTIVE_TH whose value is greater than zero but smaller than the detection time limit END,

— detection quantity SB_SUFF_TH whose value is greater than zero but smaller than or equal to the number L of sub-bands,

— minimum number SB_MIN_TH of sub-bands whose value is greater than zero but smaller than the detection quantity SB_SUFF_TH.

5　In the method according to the invention, to detect a pause in speech it is examined, on how many sub-bands the energy level has possibly remained below said power threshold value and for how long. As disclosed in the functional description of the state machine above, the pause counter C indicates how long the audio energy level has re-

10　mained below the power threshold value. Thus, the value of the counter is examined for each sub-band. If the value of the counter is greater than or equal to the detection time limit END (block 402), this means that the energy level of the sub-band has remained below the power threshold value so long that a decision on detecting a pause can be

15　made for this sub-band, *i.e.* a sub-band specific detection is made. Thus, the detection counter SB_DET_NO is preferably increased by one.

If the value of the counter is greater than or equal to the activity

20　threshold SB_ACTIVE_TH (block 404), the energy level on this sub-band has been below the power threshold value thr for a moment but not yet a time corresponding to the detection time limit END. Thus, the activity counter SB_ACT_NO in block 405 is increased preferably by one. In other cases, there is either an audio signal on the sub-band, or

25　the level of the audio signal has been below the power threshold value thr for only a short time.

Next, the operation moves on to block 406, in which the sub-band counter i used as an auxiliary variable is increased by one. On the ba-

30　sis of the value of this sub-band counter i, it can be deduced if all the sub-bands have been examined (block 407).

When the comparisons to the said pause counters have been made, it is examined, on how many sub-bands a pause was detected (the pause

35　counter was greater than or equal to the detection time limit END). If the number of such sub-bands is greater than or equal to the detection quantity SB_SUFF_TH (block 408), it is deduced in the method that there is a pause in the speech (pause detection decision, block 409),

and it is possible to move on to the actual speech recognition to find out what the user uttered. However, if the number of sub-bands is smaller than the detection quantity SB_SUFF_TH, it is examined, if the number of sub-bands including a pause is greater than or equal to the minimum

5   number of sub-bands SB_MIN_TH (block 410). Furthermore, it is examined in block 411 if any of the sub-bands is active (the pause counter was greater than or equal to the activity threshold SB_ACTIVE_TH but smaller than the detection time limit END). In the method according to the invention, a decision is made in this situation that there is a pause

10   in the speech if none of the sub-bands is active.

In a noise situation, noise on some sub-bands may effect that a detection decision cannot be made on all sub-bands even though there were a pause in the speech that should be detected. Thus, by means of said

15   sub-band minimum SB_MIN_TH, it is possible to verify the detection of a pause in the speech particularly under noise conditions. Thus, in a noise situation, if a pause is detected on at least said minimum number SB_MIN_TH of sub-bands, a pause is detected in the speech if the pause detection decision on these sub-bands remains in force for the

20   duration of said detection time limit END.

Correspondingly, under good conditions, using said detection time limit END may prevent a too quick decision on detecting a pause. Under good conditions, the said minimum number of sub-bands can quickly

25   cause a pause detection decision, even though there is no such pause in the speech to be detected. By waiting the detection time limit for substantially all of the sub-bands, it is verified that there is actually a pause in the speech.

30   In another advantageous embodiment of the invention, it is not examined before making the decision of detecting a pause whether any of the sub-bands is active. Thus, the decision on detecting a pause is made on the basis of the results of the comparisons presented above.

35   The operations presented above can be implemented advantageously *e.g.* in the application software of the controller or digital signal processor of the speech recognition device.

The above-presented method for detecting a pause in speech according to the advantageous embodiment of the invention can be applied at the stage of teaching a speech recognition device as well as at the stage of speech recognition. At the teaching stage, the disturbance conditions can be usually kept relatively constant. However, when a speech-controlled device is used, the quantity of background noise and other interference can vary to a great extent. For improving the reliability of speech recognition particularly under varying conditions, the method according to another advantageous embodiment of the invention is supplemented with adaptivity to the calculation of the threshold value thr. For achieving this adaptivity, a modification coefficient UPDATE_C is used, whose value is preferably greater than zero and smaller than one. The modification coefficient is first given an initial value within said value range. This modification coefficient is updated during speech recognition preferably in the following way. On the basis of the samples of the sub-bands stored in the buffers, a maximum power level win_max and a minimum power level win_min are calculated. After this, said calculated maximum power level win_max is compared with the power maximum p_max at the time, and said calculated minimum power level win_min is compared with the power minimum p_min. If the absolute value of the difference between the calculated maximum power level win_max and the power maximum p_max, or the absolute value of the difference between the calculated minimum power level win_min and the power minimum p_min has increased from the previous calculation time, the modification coefficient UPDATE_C is increased. On the other hand, if the absolute value of the difference between the calculated maximum power level win_max and the power maximum p_max, or the absolute value of the difference between the calculated minimum power level win_min and the power minimum p_min has decreased from the previous calculation time, the modification coefficient UPDATE_C is reduced. After this, a new power maximum and a new power minimum are calculated as follows:

$$p\_min(t) = (1 - UPDATE\_C) \cdot p\_min(t-1) + (UPDATE\_C \cdot win\_min)$$
$$p\_max(t) = (1 - UPDATE\_C) \cdot p\_max(t-1) + (UPDATE\_C \cdot win\_max)$$

The calculated new power maximum and minimum values are used at the next sampling round *e.g.* in connection with the performing of the function f(). The determination of this adaptive coefficient has *e.g.* the advantage that changes in the environmental conditions can be better taken into account in the speech recognition and the detection of a pause becomes more reliable.

The above-presented different operations for detecting a pause in the speech can be largely implemented in the application software of the controller and/or the digital signal processor of the speech recognition device. In the speech recognition device according to the invention, some of the functions, such as the division into sub-bands, can also be implemented with analog technique, which is known as such. In connection with the execution of the method, in the storing of the calculation results to be made at different stages, the variables, *etc.*, it is possible to use the memory means 14 of the speech recognition device, preferably a random access memory (RAM), a non-volatile random access memory (NVRAM), a FLASH memory, *etc.* The memory means 22 of the wireless communication device can as well be used for storing information.

Fig. 2, showing a the wireless communication device MS according to an advantageous embodiment of the invention, additionally shows a keypad 17, a display 18, a digital-to-analog converter 19, a headphone amplifier 20a, a headphone 21, a headphone amplifier 20b for a hands-free function 2, a headphone 21b, and a high-frequency block 23, all known *per se.*

The present invention can be applied in connection with several speech recognition systems functioning by different principles. The invention improves the reliability of detection of pauses in speech, which ensures the recognition reliability of the actual speech recognition. Using the method according to the invention, it is not necessary to perform the speech recognition in connection with a fixed time window, wherein the recognition delay is substantially not dependent on the rate at which the user utters speech commands. Also, the effect of background noise on speech recognition can be made smaller upon applying the method of the invention than is possible in speech recognition devices of prior art.

It is obvious that the invention is not limited solely to the embodiments presented above, but it can be modified within the scope of the appended claims.

Claims:

1. A method for detecting pauses in speech in speech recognition, in which method, for recognizing speech commands uttered by the user, the voice is converted into an electrical signal, **characterized** in that in the method, the frequency spectrum of the electrical signal is divided into two or more sub-bands, samples of the signals in the sub-bands are stored at intervals, the energy levels of the sub-bands are determined on the basis of the stored samples, a power threshold value (thr) is determined, and the energy levels of the sub-bands are compared with said power threshold value (thr), wherein the comparison results are used for producing a pause detecting result.

2. The method according to claim 1, **characterized** in that a detection time limit (END) and a detection quantity (SB_SUFF_TH) are determined, wherein in the method, the calculation of the length of a pause in a sub-band is started when the energy level of the sub-band falls below said power threshold value (thr), wherein in the method, a sub-band specific detection is performed when the calculation reaches the detection time limit (END), it is examined on how many sub-bands the energy level was below the power threshold value (thr) longer than the time detection limit (END), wherein a pause detection decision is made if the number of sub-band specific detections is greater than or equal to the detection quantity (SB_SUFF_TH).

3. The method according to claim 2, **characterized** in that in the method, also an activity time limit (SB_ACTIVE_TH) and an activity quantity (SB_MIN_TH) are determined, wherein a pause detection decision is made if the quantity of sub-band specific detections is greater than or equal to the activity quantity (SB_MIN_TH) and the activity time limit (SB_ACTIVE_TH) has not been reached on the other sub-bands in the calculation of the length of the pause in the sub-band.

4. The method according to claim 1, 2 or 3, **characterized** in that the power threshold value (thr) is calculated by the formula

$$thr = p\_min + k \cdot (p\_max - p\_min), \text{ in which}$$

p_min = the smallest power maximum determined of the stored samples of the sub-bands, and

p_max = the greatest power minimum determined of the stored samples of the sub-bands.

5

5. The method according to any of the claims 1 to 4, **characterized** in that said power threshold value (thr) is calculated adaptively by taking into account the environmental noise level at each instant.

10   6. The method according to claim 5, **characterized** in that for calculating said power threshold value (thr), a modification coefficient (UPDATE_C) is determined, and on the basis of the stored samples, the greatest power level (win_max) and the smallest power level (win_min) of the sub-bands are calculated, wherein the power maxi-

15   mum (p_max) and power minimum (p_min) are determined by the formulae:

$$p\_max(i,t) = (1 - UPDATE\_C) \cdot p\_max(i,t-1) + (UPDATE\_C \cdot win\_max)$$
$$p\_min(i,t) = (1 - UPDATE\_C) \cdot p\_min(i,t-1) + (UPDATE\_C \cdot win\_min)$$

20

in which $0 < UPDATE\_C < 1$,
$0 < i < L$, and
L is the number of sub-bands.

25   7. The method according to claim 6, **characterized** in that further in the method,

— the modification coefficient (UPDATE_C) is increased, if the absolute value of the difference between said calculated highest power level (win_max) and the power maximum (p_max), or the

30   absolute value of the difference between said calculated lowest power level (win_min) and the power minimum (p_min) has increased,

— the modification coefficient (UPDATE_C) is reduced, if the absolute value of the difference between said calculated highest

35   power level (win_max) and the power maximum (p_max), or the absolute value of the difference between said calculated lowest power level (win_min) and the power minimum (p_min) has decreased.

8. A speech recognition device (16) comprising means (1a, 1b) for converting speech commands uttered by a user into an electrical signal, **characterized** in that it also comprises:

5   — means (8) for dividing the frequency spectrum of the electrical signal into two or more sub-bands,

— means (14) for storing samples of the signals of the sub-bands at intervals,

— means (5, 13) for determining energy levels of the sub-bands on 10   the basis of the stored samples,

— means (5, 13) for determining a power threshold value (thr),

— means (5, 13) for comparing the energy levels of the sub-bands with said power threshold value (thr), and

— means (5, 13) for detecting a pause in the speech on the basis of 15   said comparison results.

9. The speech recognition device (16) according to claim 8, **characterized** in that the power threshold value is calculated by the formula

20    $thr = p\_min + k \cdot (p\_max - p\_min)$, in which

p_min =   the smallest determined power maximum of the stored samples of the sub-bands, and

p_max =   the greatest determined power minimum of the stored 25   samples of the sub-bands.

10. The speech recognition device (16) according to claim 8 or 9, **characterized** in that it comprises also means (10, 11) for filtering the signals of the sub-bands before storage.

30

11. A wireless communication device (MS) comprising means (16) for recognizing speech and means (1a, 1b) for converting speech commands uttered by a user into an electrical signal, **characterized** in that the means (16) for recognizing speech comprise also:

35   — means (8) for dividing the frequency spectrum of the electrical signal into two or more sub-bands,

— means (14) for storing samples of the signals of the sub-bands at intervals,

— means (5, 13) for determining energy levels of the sub-bands on the basis of the stored samples,

— means (5, 13) for determining a power threshold value (thr),

— means (5, 13) for comparing the energy levels of the sub-bands with said power threshold value (thr), and

5

— means (5, 13) for detecting a pause in the speech on the basis of said comparison results.

Abstract

In a method for detecting pauses in speech in speech recognition, for recognizing speech commands uttered by the user, the voice is converted into an electrical signal, whose frequency spectrum is divided into two or more sub-bands. Samples of the signals on the sub-bands are stored at intervals, the energy levels of the sub-bands are determined on the basis of the stored samples, a power threshold value (thr) is determined, and the energy levels of the sub-bands are compared with said power threshold value (thr). The comparison results are used for producing a pause detecting result.

Fig. 1

Fig 1

Fig 2

Fig 3

START

SB_ACT_NO=0
SB_DET_NO=0
i=0
401

C(i)>=END?
402

yes

SB_DET_NO=
SB_DET_NO+1
403

no

C(i)>=
SB_ACTIVE_TH?
404

yes

SB_ACT_NO=
SB_ACT_NO+1

405

no

i = i + 1
406

i < L?
407

yes

no

SB_DET_NO>=
SB_SUFF_TH?
408

yes

no

SB_DET_NO>=
SB_MIN_TH?
410

yes

SB_ACT_NO==0?
411

yes

no

no

Pause detection
409

END
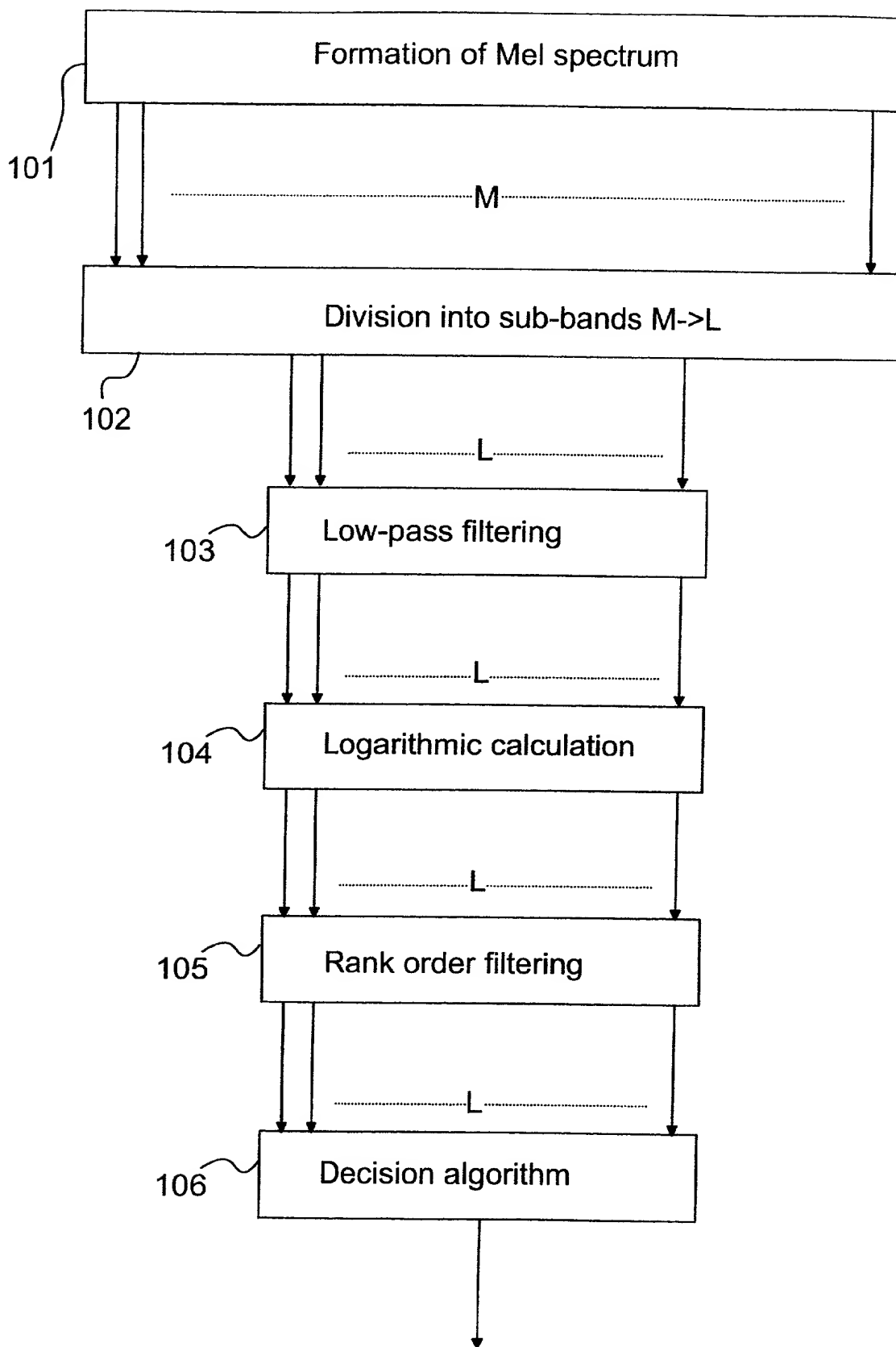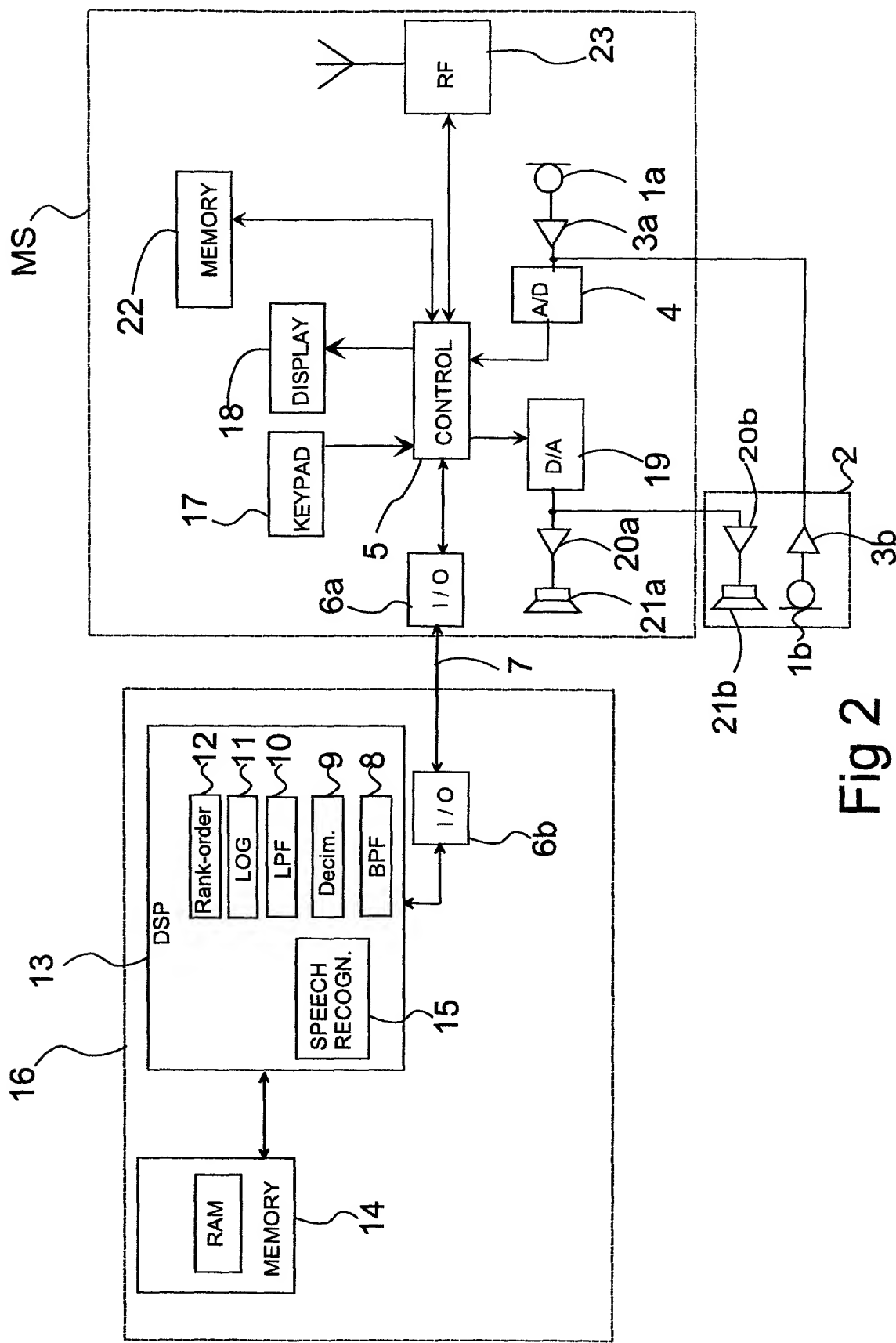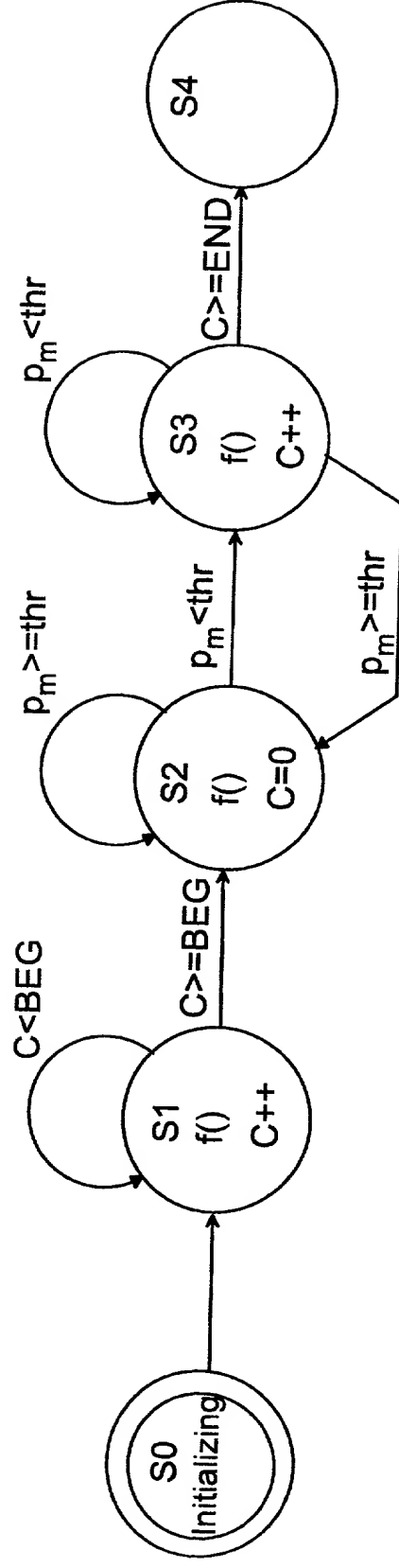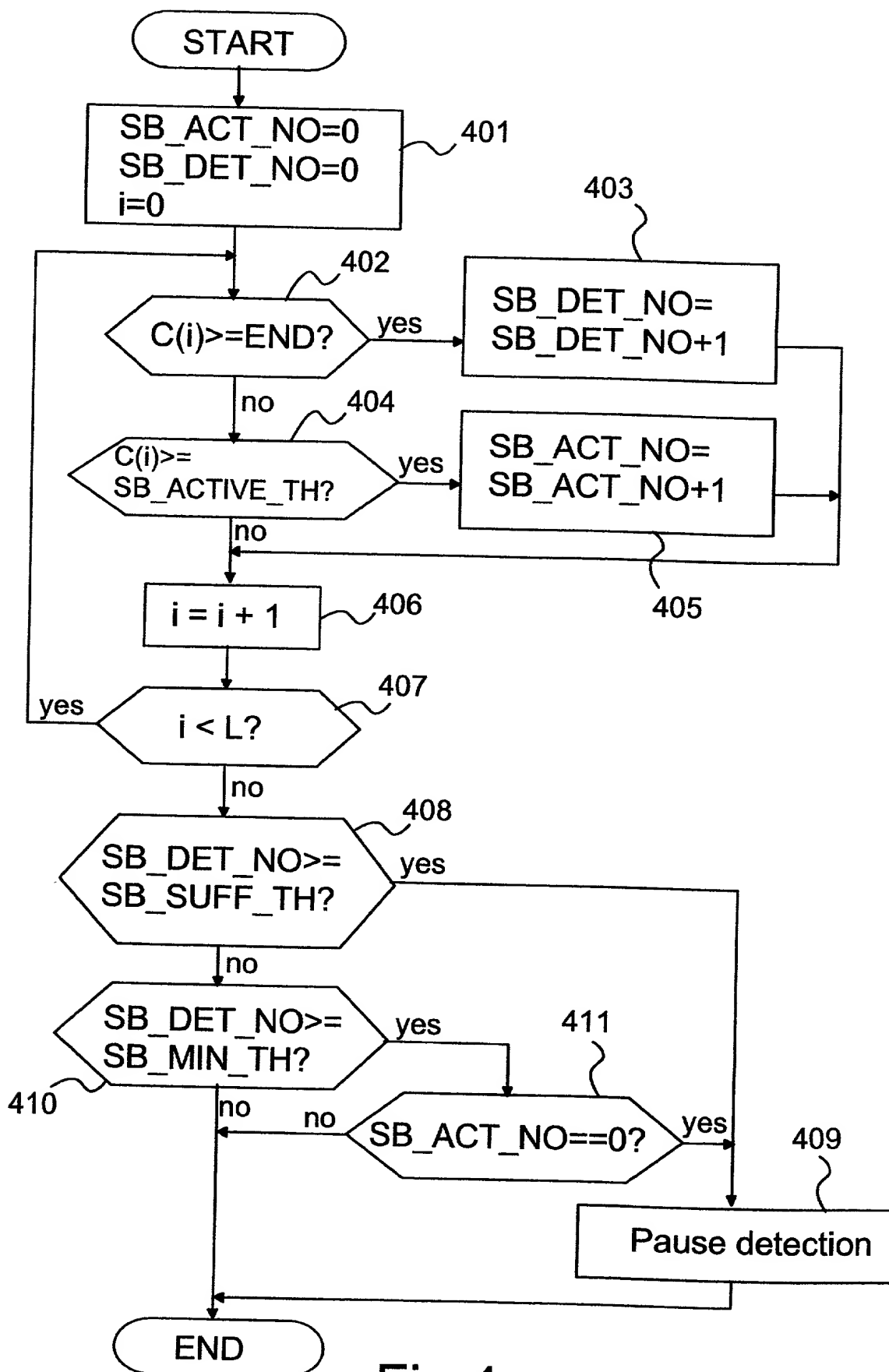
Fig 4

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

(check one applicable item below)

[x] original.

[ ] design.

[ ] supplemental.

NOTE: *If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.*

[ ] national stage of PCT.

NOTE: *If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.*

[ ] divisional.

[ ] continuation.

[ ] continuation-in-part (C-I-P).

INVENTORSHIP IDENTIFICATION

WARNING: *If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

Method in speech recognition and a speech recognition device

_____

_____

SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b), or (c))

(a) $\boxed{\text{x}}$ is attached hereto

(b) ☐ was filed on _____ as ☐ Serial No. 0/ _____
    or ☐ Express Mail No., As Serial No. not yet known _____
    and was amended on _____ *(if applicable)*.

NOTE: *Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.*

(c) ☐ was described and claimed in PCT International Application No.
    _____ , filed on _____ and as
    amended under PCT Article 19 on _____ *(if any)*.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

$\boxed{\text{x}}$ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C § 119(a)–(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)–(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e)

(d) ☐ no such applications have been filed.

(e) $\boxed{\text{x}}$ such applications have been filed as follows.

NOTE: *where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.*

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)–(d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Finland	990078	18 January 1999	[x] YES NO [ ]
			[ ] YES NO [ ]
			[ ] YES NO [ ]
			[ ] YES NO [ ]
			[ ] YES NO [ ]

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER   FILING DATE

_____ / _____   _____

_____ / _____   _____

_____ / _____   _____

_____ / _____   _____

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)
UNDER 35 U.S.C. 120

[ ] The claim for the benefit of any such applications are set forth in the attached
ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY
FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART (C-I-P)
APPLICATION

ALL FOREIGN APPLICATION(S), *IF ANY,* FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

_____

_____

_____

NOTE: *If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.*

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Clarence A. Green	(24,622)
Harry F. Smith	(32,493)
Mark F. Harrington	(31,686)

(check the following item, if applicable)

☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

Clarence A. Green
Perman & Green, LLP
425 Post Road
Fairfield, CT 06430

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)
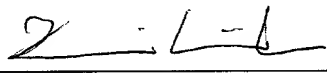Clarence A. Green
(203) 250-1800

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

Full name of sole or first inventor

Kari   Laurila

(GIVEN NAME)   (MIDDLE INITIAL OR NAME)   FAMILY (OR LAST NAME)

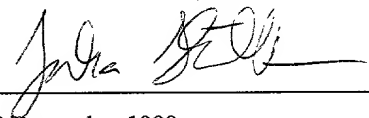Inventor's signature

Date   20 December 1999   Country of Citizenship   Finland

Residence   Insinöörinkatu 64 A 14, FIN-33720 Tampere, Finland

Post Office Address   Insinöörinkatu 64 A 14, FIN-33720 Tampere, Finland

Full name of second joint inventor, if any

Juha   Häkkinen

(GIVEN NAME)   (MIDDLE INITIAL OR NAME)   FAMILY (OR LAST NAME)

Inventor's signature

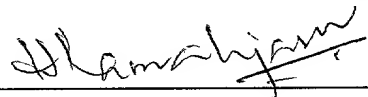Date   20 December 1999   Country of Citizenship   Finland

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Full name of third joint inventor, if any

Ramalingam   Hariharan

(GIVEN NAME)   MIDDLE INITIAL OR NAME   FAMILY (OR LAST NAME)

Inventor's signature

Date   20 December 1999   Country of Citizenship   India

Residence   Lindforsinkatu 6 A 12, FIN-33720 Tampere, Finland

Post Office Address   Lindforsinkatu 6 A 12, FIN-33720 Tampere, Finland

(check proper box(es) for any of the following added page(s)
that form a part of this declaration)

☐ **Signature** for fourth and subsequent joint inventors. *Number of pages added* _____

* * *

☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or
incapacitated inventor. *Number of pages added* _____

* * *

☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized
under 37 CFR 1.47. *Number of pages added* _____

* * *

☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal
representative cannot be appointed in time. (37 CFR 1.47)

* * *

☐ Added pages to combined declaration and power of attorney for divisional, continuation, or
continuation-in-part (C-I-P) application.

☐ Number of pages added _____

* * *

☐ Authorization of attorney(s) to accept and follow instructions from representative.

* * *

(if no further pages form a part of this Declaration,
then end this Declaration with this page and check the following item)

☒ This declaration ends with this page.